TIEBACK INSTALLATION PROCEDURE

1. A MINIMUM 3⅜"ø HOLE SHALL BE DRILLED USING ROTARY OR PERCUSSION DRILLING TO THE ANGLE AND DEPTH SHOWN. IF CAVING OF THE DRILL HOLE OCCURS, THEN A CASING SHALL BE INSTALLED AS NECESSARY TO MAINTAIN AN OPEN HOLE. THIS CASING SHALL BE WITHDRAWN DURING THE GROUTING OPERATION.

2. THE DRILL HOLE SHALL BE GROUTED FROM THE BOTTOM EITHER BEFORE OF AFTER THE TENDON INSTALLATION. THE GROUT SHALL BE A NEAT CEMENT GROUT CONSISTING OF TYPE I, II, OR III CEMENT AND POTABLE WATER WITH A 0.50 WATER–CEMENT RATIO (5½ GALLONS OF WATER PER 93 LB. BAG OF CEMENT). ADDITIVES TO IMPROVE THE FLOWABILITY MAY BE USED.

3. IF THE TIEBACK IS TO BE RE–GROUTED, THIS SHOULD BE DONE WITHIN 24 HOURS OF THE INITIAL GROUTING OPERATION.

4. THE TIEBACKS MAY BE TESTED 5 DAYS (3 DAYS WITH TYPE III CEMENT OR PRESSURE INJECTED ANCHORS) AFTER THE FINAL GROUTING.

TIEBACK TESTING PROCEDURE

THE FOLLOWING TIEBACK TESTING PROCEDURES SHALL BE CAREFULLY FOLLOWED. EACH TIEBACK SHALL BE TESTED. THE MAXIMUM TEST LOAD SHALL NOT EXCEED 80 PERCENT OF THE GUARANTEED MINIMUM ULTIMATE TENSILE STRENGTH OF THE TENDON. THE TEST LOAD SHALL BE SIMULTANEOUSLY APPLIED TO THE ENTIRE TENDON. THE TIEBACK TESTING EQUIPMENT SHALL CONSIST OF:

1. A DIAL GAUGE ACCURATE TO 0.001 INCHES TO MEASURE THE TIEBACK MOVEMENT.

2. A HYDRAULIC JACK AND PUMP TO APPLY THE TEST LOAD. THE CALIBRATED PRESSURE GAUGE SHALL BE GRADUATED IN 100 PSI INCREMENTS OR LESS. THE HYDRAULIC PUMP SHALL BE CAPABLE OF RAISING THE LOAD FROM ONE LOAD INCREMENT TO ANOTHER IN LESS THAN 30 SECONDS.

PERFORMANCE TEST

THE FIRST 3 TIEBACKS AND 3% OF THE REMAINING TIEBACKS SHALL BE PERFORMANCE TESTED IN ACCORDANCE WITH THE FOLLOWING PROCEDURES. ALL OTHER ANCHORS SHALL BE PROOF TESTED.

THE PERFORMANCE TEST SHALL BE MADE BY INCREMENTALLY LOADING AND UNLOADING THE TIEBACK IN ACCORDANCE WITH THE FOLLOWING SCHEDULE. THE TIEBACK MOVEMENTS SHALL BE MEASURED FROM THE INITIAL ALIGNMENT LOAD AND RECORDED TO THE NEAREST 0.001 INCHES WITH RESPECT TO AN INDEPENDENT FIXED REFERENCE POINT AT SUBSEQUENT ALIGNMENT LOADS AND AT EACH INCREMENT OF LOAD. THE TEST LOAD SHALL BE MONITORED WITH A CALIBRATED PRESSURE GAUGE.

PERFORMANCE TEST SCHEDULE:

AL	0.50 DL	AL	0.25 DL
0.25 DL	0.75 DL *	0.25 DL	0.50 DL
AL	AL	0.50 DL	0.75 DL
0.25 DL	0.25 DL	0.75 DL	1.00 DL
0.50 DL *	0.50 DL	1.00 DL	1.20 DL
AL	0.75 DL	1.20 DL *	1.33 DL * TEST LOAD
0.25 DL	1.00 DL *	AL	1.00 DL LOCK–OFF LOAD

WHERE: AL IS THE ALIGNMENT LOAD; DL IS THE DESIGN LOAD

THE MAXIMUM TEST LOAD IN A PERFORMANCE TEST SHALL BE HELD FOR 10 MINUTES. THE TIEBACK MOVEMENT WITH RESPECT TO A FIXED REFERENCE SHALL BE MEASURED AND RECORDED AT 1 MINUTE, 2, 3, 4, 5, 6, AND 10 MINUTES. IF THE TIEBACK MOVEMENT BETWEEN 1 MINUTE AND 10 MINUTES EXCEEDS 0.04 INCHES, THE MAXIMUM TEST LOAD SHALL BE HELD FOR AN ADDITIONAL 50 MINUTES. IF THE LOAD HOLD IS EXTENDED, THE TIEBACK MOVEMENT SHALL BE RECORDED AT 15 MINUTES, 20, 25, 30, 45, AND 60 MINUTES. THE LOAD HOLD TIME SHALL BEGIN WHEN THE PUMP STARTS TO RAISE THE LOAD FROM THE 1.20 DL LOAD INCREMENT TO THE 1.33 DL LOAD INCREMENT.

THE CONTRACTOR SHALL PLOT THE TIEBACK MOVEMENT VERSUS LOAD FOR EACH LOAD INCREMENT MARKED WITH AN ASTERISK (*) IN THE PERFORMANCE TEST SCHEDULE AND PLOT THE RESIDUAL MOVEMENT OF THE TENDON AT EACH ALIGNMENT LOAD VERSUS THE HIGHEST PREVIOUSLY APPLIED LOAD.

PROOF TEST

THE PROOF TEST SHALL BE MADE BY INCREMENTALLY LOADING THE TIEBACK IN ACCORDANCE WITH THE FOLLOWING SCHEDULE. THE TIEBACK MOVEMENTS SHALL BE MEASURED FROM THE INITIAL ALIGNMENT LOAD AND RECORDED TO THE NEAREST 0.001 INCHES WITH RESPECT TO AN INDEPENDENT FIXED REFERENCE POINT AT EACH ALIGNMENT OF LOAD

AL	0.50 DL	1.20 DL
0.25 DL	0.75 DL	1.00 DL LOCK–OFF LOAD
	1.00 DL	

WHERE AL IS THE ALIGNMENT LOAD; DL IS THE DESIGN LOAD.

THE MAXIMUM TEST LOAD IN A PROOF TEST SHALL BE HELD FOR 10 MINUTES. THE TIEBACK MOVEMENT WITH RESPECT TO A FIXED REFERENCE SHALL BE MEASURED AND RECORDED AT 1 MINUTE, 2, 3, 4, 5, 6, AND 10 MINUTES. IF THE TIEBACK MOVEMENT BETWEEN 1 MINUTE AND 10 MINUTES EXCEEDS 0.04 INCHES, THE MAXIMUM TEST LOAD SHALL BE RECORDED AT 15 MINUTES, 20, 25, 30, 45, AND 60 MINUTES. THE LOAD HOLD TIME SHALL BEGIN WHEN THE PUMP STARTS TO RAISE THE LOAD FROM THE 1.00 DL LOAD INCREMENT TO THE 1.20 DL LOAD INCREMENT.

THE CONTRACTOR SHALL PLOT THE TIEBACK MOVEMENT VERSUS THE LOAD FOR EACH INCREMENT.

TIEBACK TEST ACCEPTANCE CRITERIA

A PERFORMANCE OR PROOF TEST TIEBACK WITH A 10 MINUTE LOAD IS ACCEPTABLE IF:

1. THE TIEBACK WILL CARRY THE MAXIMUM TEST LOAD WITH NOT MORE THAN 0.04 INCHES OF MOVEMENT BETWEEN 1 MINUTE AND 10 MINUTES.

2. THE TOTAL MOVEMENT AT THE MAXIMUM TEST LOAD EXCEEDS 80 PERCENT OF THE THEORETICAL ELASTIC ELONGATION OF THE UNBONDED LENGTH.

A PERFORMANCE OR PROOF TESTED TIEBACK WITH A 60 MINUTE HOLD IS ACCEPTABLE IF:

1. THE TIEBACK WILL CARRY THE MAXIMUM TEST LOAD WITH NOT MORE THAN 0.08 INCHES OF MOVEMENT IN A LOG CYCLE OF TIME (E.G. BETWEEN 6 MINUTES AND 60 MINUTES).

2. THE TOTAL MOVEMENT AT THE MAXIMUM TEST LOAD EXCEEDS 80 PERCENT OF THE THEORETICAL ELASTIC ELONGATION OF THE UNBONDED LENGTH.

TIEBACKS WHICH FAIL TO MEET THE ACCEPTANCE CRITERIA DURING TESTING CAN BE INCORPORATED IN THE FINISHED WALL AT A LOAD EQUAL TO 50% OF THEIR FAILURE LOAD. TO DETERMINE THE FAILURE LOAD, ALLOW THE LOAD TO STABILIZE FOR 10 MINUTES AFTER THE TIEBACK HAS FAILED. WHEN A TIEBACK FAILS, THE CONTRACTOR SHALL MODIFY THE DESIGN AND/OR THE CONSTRUCTION PROCEDURES. THESE MODIFICATIONS MAY INCLUDE, BUT ARE NOT LIMITED TO INSTALLING ADDITIONAL TIEBACKS, REDUCING THE TIEBACK DESIGN LOAD BY INCREASING THE NUMBER OF TIEBACKS, MODIFYING THE INSTALLATION METHODS, INCREASING THE ANCHOR LENGTH, OR CHANGING THE TIEBACK TYPE. IF RE–GROUTABLE TIEBACK ANCHORS ARE USED, A FAILED ANCHOR MAY BE RE–GROUTED AND RE–TESTED ACCORDING TO PTI STANDARD RECOMMENDATIONS.

TIEBACK TENDON TYPE & SIZE		MAX. DESIGN LOAD
0.6"ø, 270 KSI	2 STRANDS	70.3 KIPS
	3 STRANDS	105.4 KIPS
	4 STRANDS	140.6 KIPS
1"ø, 150 KSI THREADBAR		76.5 KIPS
1 1/4"ø, 150 KSI THREADBAR		112.5 KIPS
1 3/8"ø, 150 KSI THREADBAR		142.2 KIPS

SHEET PILE WALL SCHEDULE – SOUTH SIDE

SECTION	SHEET PILE SIZE	TIEBACK – LEVEL 1				TIEBACK – LEVEL 2				TIEBACK – LEVEL 3				TIEBACK – LEVEL 4			
		D.L. @ 20' (KIPS)	ELEV.	SPACING (FT)	WALE	D.L. @ 15' (KIPS)	ELEV.	SPACING (FT)	WALE	D.L. @ 15' (KIPS)	ELEV.	SPACING (FT)	WALE	D.L. @ 15' (KIPS)	ELEV.	SPACING (FT)	WALE
A	AZ 26	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
B	AZ 26	100	18	12.4	2C15x33.9	–	–	–	–	–	–	–	–	–	–	–	–
C	AZ 26	116	19	8.27	2C12x30	–	–	–	–	–	–	–	–	–	–	–	–
D	AZ 26	93	23	8.27	2C12x25	77	12	8.27	2C12x25	110	2	8.27	2C12x25	–	–	–	–
E	AZ 26	114	26.5	12.4	2C15x33.9	111	15	12.4	2C15x33.9	–	–	–	–	–	–	–	–
F	AZ 36	111	VARIES	8.27	2C12x25	108	18.5	8.27	2C12x25	92	9.5	8.27	2C12x25	101	1	4.14	2C12x25
G	AZ 26	106	17	12.4	2C15x33.9	–	–	–	–	–	–	–	–	–	–	–	–
H	AZ 26	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

SHEET PILE WALL SCHEDULE – NORTH SIDE

SECTION	SHEET PILE SIZE	TIEBACK – LEVEL 1				TIEBACK – LEVEL 2				TIEBACK – LEVEL 3			
		D.L. @ 15' (KIPS)	ELEV.	SPACING (FT)	WALE	D.L. @ 15' (KIPS)	ELEV.	SPACING (FT)	WALE	D.L. @ 15' (KIPS)	ELEV.	SPACING (FT)	WALE
I	AZ 26	–	–	–	–	–	–	–	–	–	–	–	–
J	AZ 26	–	–	–	–	–	–	–	–	–	–	–	–
K	AZ 26	71	18	12.4	2C12x30	–	–	–	–	–	–	–	–
L	AZ 36	112	25	8.27	2C12x30	123	11	8.27	2C12x30	105	1	4.14	2C12x25
M	AZ 26	109	22	8.27	2C12x25	–	–	–	–	–	–	–	–
N	AZ 26	110	19	8.27	2C12x30	68	5	4.14	2C12x25	–	–	–	–
O	AZ 26	95	17	8.27	2C12x25	–	–	–	–	–	–	–	–
P	AZ 26	88	17	12.4	2C12x30	–	–	–	–	–	–	–	–
Q	AZ 26	–	–	–	–	–	–	–	–	–	–	–	–

SHEET PILE WALL SCHEDULE – SOUTH SIDE

SECTION	SHEET PILE SIZE	TOP OF PILE ELEVATION	SOIL ELEVATION IN FRONT OF WALL	SOIL ELEVATION IN BACK OF WALL	NO. OF DOUBLE SHEETS	SECTION LENGTH (FT)	SHEET PILE LENGTH (FT)	SHEET PILE WALL TYPE
A	AZ 26	24.0	15.0	22.5	9	37.16	16.7	CANTILEVER
B	AZ 26	26.5	7.0	25.0	12	49.58	26.5	ANCHORED
C	AZ 26	28.5	2.0	27.0	15	62.0	42.0	ANCHORED
D	AZ 26	32.0	–6.0	30.5	18	74.42	58.0	ANCHORED
E	AZ 26	34.5	4.0	33.0	16	66.17	36.0	ANCHORED
F	AZ 36	39.0	–11.0	37.5	30	124.0	80.0	ANCHORED
G	AZ 26	28.5	5.0	27.0	5	20.67	31.0	ANCHORED
H	AZ 26	18.5	5.0	17.0	5	20.67	26.7	CANTILEVER

SHEET PILE WALL SCHEDULE – NORTH SIDE

SECTION	SHEET PILE SIZE	TOP OF PILE ELEVATION	SOIL ELEVATION IN FRONT OF WALL	SOIL ELEVATION IN BACK OF WALL	NO. OF DOUBLE SHEETS	SECTION LENGTH (FT)	SHEET PILE LENGTH (FT)	SHEET PILE WALL TYPE
I	AZ 26	17.5	7.0	16.0	9	37.16	19.7	CANTILEVER
J	AZ 26	21.5	7.0	20.0	3	12.42	28.6	CANTILEVER
K	AZ 26	27.0	7.0	25.5	3	12.42	25.5	ANCHORED
L	AZ 36	33.5	–11.0	32.0	30	124.0	74.0	ANCHORED
M	AZ 26	31.5	7.0	30.0	15	62.0	35.0	ANCHORED
N	AZ 26	28.5	–6.0	27.0	20	82.67	53.5	ANCHORED
O	AZ 26	26.5	2.0	25.0	9	37.17	35.0	ANCHORED
P	AZ 26	24.5	5.3	23.0	12	49.58	26.5	ANCHORED
Q	AZ 26	23.5	14.5	22.0	8	33.08	19.0	CANTILEVER

JOHN J. PEIRCE JR. REGISTERED No. 6470 DELAWARE PROFESSIONAL ENGINEER

JOHN J. PEIRCE JR.
5/24/05
DELAWARE PROFESSIONAL ENGINEER
LICENSE No. 6470

PEIRCE ENGINEERING, INC.
3736 Stoughton Road Collegeville, PA 19426 PH./FAX (610)489–1163
Civil – Construction Engineering

KUHN CONSTRUCTION COMPANY
P.O. BOX 1419 HOCKESSIN, DELAWARE 19707

DELAWARE RIVER SEASHORE STATE PARK
BR 3–156 INDIAN RIVER INLET
FEDERAL AID PROJECT NO. BROS–S050(7)
TIETESTING NOTES AND SCHEDULES

NO.	REVISIONS	DATE	APP'D
1	FIGG REVIEW COMMENTS DATED 6/17/05	6/27/05	

DESIGNED: JJP | CHK'D: JPB | DRAWN: JPB | CHK'D: JJP

DWG. NAME: SHEETING.DWG | STRUCTURE NO.

SCALE: AS NOTED | CONTRACT NO. 27–073–03 | DWG. NO. | SHEET NO. 6 OF 6